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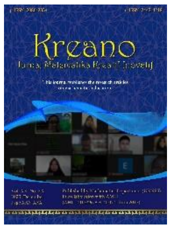

Integrating SQ3R Strategies to Improve Mathematical Problem-Solving Capabilities in Material Triangles

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Abstract

Indonesian students often struggle with solving math problems, especially when it comes to geometry, like problems involving triangles. However, previous studies have mostly focused on SQ3R in reading comprehension or general mathematics learning, leaving a gap in its application to geometry-based problem-solving. This study aims to examine the effectiveness of integrating the SQ3R strategy to enhance students' mathematical problem-solving abilities on triangle materials. The research used a quantitative-qualitative method with a quasi-experimental design, and included two groups: an experimental group and a control group. The students were from a seventh-grade class at SMP Negeri 4 Cimahi, and they were divided into the two groups based on purposeful selection. Data was gathered through problem-solving tests, classroom observations, and other records. The results showed that the group that used SQ3R improved much more in their problem-solving skills compared to the group that didn't use it. The SQ3R method helped students break down problems, come up with plans, do calculations, and check their answers in a better way. This study highlights the need for active literacy-based strategies in mathematics instruction and suggests future research to explore the broader application of SQ3R in other mathematical topics and grade levels.

Keywords: Quasi-Experimental Design; Geometry; Student Engagement; Mathematics Problem-Solving; SQ3R Strategy.

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Abstrak

Keterampilan siswa Indonesia dalam pemecahan masalah matematika masih dianggap rendah, terutama dalam pelajaran geometri seperti segitiga. Namun, penelitian sebelumnya sebagian besar berfokus pada penerapan SQ3R dalam keterampilan membaca atau pembelajaran matematika secara umum, sehingga masih terdapat kesenjangan dalam penerapannya pada pemecahan masalah berbasis geometri. Penelitian ini bertujuan untuk menguji efektivitas integrasi strategi SQ3R dalam meningkatkan kemampuan pemecahan masalah matematis siswa pada materi segitiga. Penelitian ini mengambil pendekatan kuantitatif-kualitatif dan menerapkan metode kuasi eksperimen berjenis Non-equivalent Control Group Design. Sampel terdiri dari 72 siswa kelas VII di SMP Negeri 4 Cimahi yang dibagi menjadi kelompok eksperimen dan kontrol, keduanya dipilih secara purposif. Alat penelitian terdiri dari tes penyelesaian masalah, pengamatan, dan dokumentasi. Temuan penelitian menunjukkan peningkatan yang signifikan dalam kemampuan pemecahan masalah siswa pada kelompok eksperimen dibandingkan dengan kelompok kontrol. Strategi SQ3R terbukti berhasil mendukung siswa dalam memahami permasalahan, merancang solusi, melakukan perhitungan, dan memeriksa hasil secara terstruktur. Penelitian ini menegaskan pentingnya penerapan strategi berbasis literasi aktif dalam pembelajaran matematika serta merekomendasikan penelitian lanjutan untuk mengeksplorasi penerapan SQ3R pada topik matematika dan jenjang pendidikan lainnya.

INTRODUCTION

Problem-solving skills are a key part of learning mathematics that students need to understand well. In the Independent Curriculum and many other education policies, this skill is important for helping students develop their ability to think critically and analyze things carefully. But research shows that Indonesian students still have low levels of math problem-solving ability. Findings from the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) indicate that Indonesian students frequently face challenges with questions requiring reasoning and the application of mathematical concepts in practical scenarios (Amalina & Vidákovich, 2023; Mulyani et al., 2024; Nadhiroh & Anshori, 2023; Pradiarti & Subanji, 2022; Zulaiha et al., 2023). One of the topics that is often a source of difficulty is geometry at both the elementary school and secondary school levels, especially triangle material in mathematics learning in Indonesia in 2017-2023, which requires the ability to visualize space, logic, and mastery of basic concepts in an integrated manner in mathematics learning at the junior high school level (Fauzi & Arisetyawan, 2020; Fitriyana & Nursyahidah, 2022; Hou et al., 2023; Pamungkas, 2018; Saputro et al., 2015; Sari, 2024; Velázquez & Méndez, 2021).

This low ability can be due to the lack of a learning approach that stimulates active thinking and the student's overall involvement in the process of understanding and solving problems. So far, mathematics learning is still dominated by conventional approaches that emphasize mechanistic procedures and memorization of formulas, without providing enough space for students to develop reflective and critical thinking strategies. Therefore, a learning strategy is needed that is able to bridge the literacy and problem-solving aspects of mathematics, as well as enable cognitive student involvement in each stage of the learning process. Student involvement, to student learning achievement, especially in mathematics learning (Abidin, 2020; Jeheman et al., 2019; Mulyani et al., 2024).

The Survey, Question, Read, Recite, and Review (SQ3R) strategy is one of the active reading techniques that has been widely used to improve reading comprehension at various levels of education. Some studies have shown that this strategy is effective in improving students' understanding of reading texts because it activates systematic and repetitive thinking processes. Although originally developed for reading literacy, the SQ3R strategy has great potential to be adapted in mathematics learning, particularly in understanding concepts and solving problems that require in-depth analysis. By applying the stages in SQ3R to mathematical problem solving, students are encouraged to pre-analyze the problem, formulate questions, read relevant information, review understanding, and reflect on solutions (Cataraja, 2022; Dong & Dong, 2023; Misnawan et al., 2020; Mustafa et al., 2024; Stahl & Armstrong, 2020).

The urgency of this research lies in the need for innovation in mathematics learning strategies that not only focus on the final result, but also on the students' thinking process in solving problems. Active literacy strategies such as SQ3R have been shown to be effective in improving understanding of concepts in a variety of contexts. For example, Riansyah (2022) showed that the application of the SQ3R method in high school students resulted in a significant improvement in understanding of mathematical concepts, with the average score of the experimental group (54.12) much higher than that of the control group (22.34). Similarly, research by Rahayuningsih and Kristiawan (2021) on students shows that SQ3R is able to encourage independent learning activities which has an impact on the level of concept understanding by 84.25%. However, previous studies have not specifically examined the application of the SQ3R strategy in mathematics learning, especially in geometry topics such as triangles, nor have they explored its potential to enhance students' mathematical problem-solving skills. This indicates a clear research gap that this study aims to address.

While earlier studies have demonstrated the effectiveness of SQ3R in improving reading comprehension and conceptual understanding, few have investigated its role in fostering mathematical reasoning and problem-solving within geometry. Therefore, this study seeks to extend the application of SQ3R beyond literacy contexts into mathematics learning, highlighting its novelty in integrating reading-based strategies with mathematical cognition.

Although the SQ3R strategy has been extensively researched and proven to be effective in learning outside of mathematics learning, with the application of SQ3R in other learning to improve students' reading comprehension, its application in mathematics learning is still very limited, especially in the context of developing problem-solving skills (Dewi & Ganing, 2020). Most research on SQ3R has focused on language or literacy subjects, and few have examined how the stages in this strategy can be used to improve conceptual understanding and analytical skills in mathematics. On the other hand, studies that address improving mathematical problem-solving skills more often use problem-based learning (PBL) approaches, heuristic approaches, or cooperative strategies, without integrating active literacy techniques such as SQ3R (Fadzil & Osman, 2025). This difference highlights the novelty of the present study, which combines active literacy techniques with mathematical problem-solving in the geometry domain (Juliawan et al., 2017).

In addition, the topic of triangles as part of basic geometry is one of the important but also complex subjects, which demands simultaneous conceptual understanding and spatial visualization. However, studies on the effectiveness of active literacy-based learning strategies on this topic are still very limited. Therefore, this study aims to fill these gaps by analyzing the effectiveness of the SQ3R strategy in improving problem-solving skills in triangle material among junior high school students (Ferede et al., 2025).

This study contributes to the existing literature by providing empirical evidence on how SQ3R can be adapted to mathematics learning, particularly in geometry problem-solving. Practically, the findings are expected to guide teachers in integrating active literacy strategies into mathematics instruction to enhance students' analytical, reasoning, and problem-solving skills.

METHOD

This study adopted a quantitative approach with a quasi-experimental design. This design was chosen because the researcher could not fully control all external variables that might affect learning outcomes, but it still enabled an empirical assessment of the treatment's impact on the dependent variables. The research applied a non-equivalent control group design, comprising two groups selected through purposive sampling: an experimental group taught using the SQ3R (Survey, Question, Read, Recite, Review) strategy, and a control group that received conventional instruction (Isnawan, 2020).

The research procedure was carried out in stages, including preparation, implementation of learning strategies, data collection, and data analysis. These steps were systematically arranged to ensure that the SQ3R strategy was consistently applied in the experimental class, while the control group followed conventional learning methods (Arikunto et al., 2015).

Although this study primarily used a quantitative quasi-experimental design, supporting qualitative techniques (namely classroom observations and brief semi-structured interviews) were also employed to strengthen the interpretation of the quantitative results. These qualitative components were not used to change the overall research design into a mixed-methods study, but rather to provide contextual understanding of how the SQ3R strategy was implemented and how students engaged during the learning process.

Research Procedure

The participants were seventh-grade students from SMP 4 Cimahi who had similar academic performance and learning facilities. Sampling was conducted purposively, taking into account teacher recommendations and results of preliminary observations. The purpose was to examine differences in mathematical problem-solving skills between students taught with the SQ3R strategy and those taught with conventional methods. Each group comprised 36 students, yielding an equal number in both experimental and control groups. As a comparison, the control group was taught through commonly used classroom practices.

Instrument reliability was tested using the Cronbach's Alpha coefficient since the instrument contained more than two items, and internal consistency was a key requirement. The reliability coefficient obtained was 0.82, which falls into the high category according to Guilford's criteria, confirming that the instrument was appropriate for use. In addition, each item was analyzed for difficulty and discriminating power, with minor revisions made to two items that contained unclear wording. The criteria for mathematical problem-solving ability are summarized in Table 1. Scores from all items within each indicator were averaged to classify students' abilities into categories (Cronbach, 1951).

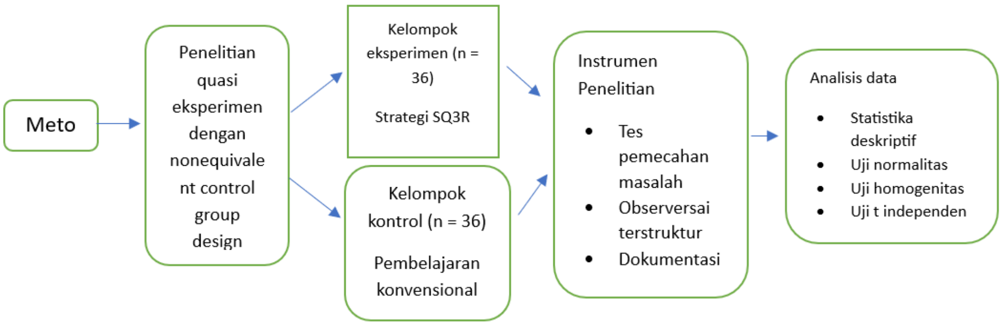

Figure 1. Research Procedure

The subject of the study is a grade VII student of SMP 4 Cimahi who has equivalent characteristics in terms of academic achievement and learning facilities. Class selection is carried out purposively based on the consideration of the subject teacher and the results of initial observation. This research seeks to identify the difference in problem-solving abilities between students engaged in learning using the SQ3R strategy and those who use traditional methods. The experimental group consisted of 36 students, as well as the control group of the same number. As a comparison, the control group used a conventional learning approach that teachers usually apply.

The reliability test was carried out using the *Alpha Cronbach coefficient*, because the instrument has more than two questions, is homogeneous, and is measured by one main assessor so that the calculation of internal consistency is a priority. The calculation results showed a reliability coefficient of 0.82, which according to Guilford's criteria was in the high category, so the instrument was declared suitable for use. In addition, each question item was analyzed for the level of difficulty and differentiating power to ensure the quality of the item, and minor improvements were made to two questions that had unclear redactions. The criteria for problem-solving ability can be seen in Table 1. The score of all students in each indicator is then calculated to find out the average achievement and category of students' abilities (Cronbach, 1951).

Table 1. Classification of Mathematics Problem-Solving Ability Test Results

Average	Criterion
$90° \leq A < 100\%$	Excellent
$75° \leq A < 90\%$	Good
$55^0 \leq C < 75\%$	Enough
$40^0 \leq D < 55\%$	Less
$0^0 \leq E < 40\%$	Ugly

The main data were obtained from students' pretest and posttest scores on mathematical problem-solving tests. Meanwhile, observations were conducted to monitor the implementation fidelity of the SQ3R strategy and students' participation during the learning sessions. The observation checklist included indicators such as student engagement, question formulation, and reflection activities. In addition, short semi-structured interviews were conducted with selected students and teachers to gather supplementary insights about their experiences and perceptions of the SQ3R strategy.

Data analysis goes through several steps. First, the numbers from the test are checked to see if they follow a normal pattern and if they have similar spread. Then, a test called independent sample t-test is used to find out if there are differences between the groups. Another test, called paired sample t-test, is used to check if there is improvement within each group. Qualitative data from observations, documentation, and interviews were used only to support and explain the quantitative findings. These data were analyzed descriptively and triangulated with test results to ensure consistency and validity of interpretations.

Thus, even though observations and interviews were included in the data collection process, the study remains primarily quantitative in design, with qualitative elements serving to enrich interpretation rather than form an equal part of a mixed-methods approach.

RESULT AND DISCUSSION

Results

The research results show that using the SQ3R strategy on triangular topics greatly improved students' ability to solve math problems. When looking at the data, there was a clear increase in the scores for each part of problem-solving skills, when comparing the scores before and after the strategy was used in the experimental group.

Students' mathematical problem-solving performance was assessed through both pretests and posttests to empirically determine the impact of the SQ3R strategy. The pretest served to evaluate the equivalence of initial abilities between the experimental and control groups, while the posttest was administered to measure the effectiveness of the treatment after the learning process.

The comparison of pretest and posttest results provided evidence of the progression in students' problem-solving skills before and after the learning intervention. Initially, the pretest confirmed that the groups possessed comparable baseline abilities prior to treatment. Subsequently, the posttest was done to check how much each group improved. One group used the SQ3R strategy, and the other group followed regular teaching methods.

The results of the mathematical problem-solving skills of students from each class show different results, which can be seen in Table 2.

Table 2. Descriptive statistics Pretest Students' Mathematical Problem-Solving Ability

Class	N	Mean	SD	Min	Max
Experimen (SQ3R)	36	51.11	5.8	17	82
Control (Conventional)	36	50.31	5.4	17	78

Table 2 illustrates that the pretest outcomes of both groups are relatively equivalent, both in terms of mean scores and data distribution. These results indicate that prior to the intervention, the groups possessed a similar level of initial competence. Such equivalence provides a valid foundation for making an objective comparison of the treatment effects in subsequent stages.

After the instructional intervention, a posttest was conducted to assess performance differences between the experimental group, which was taught using the SQ3R method, and the control group that received standard lessons. The outcomes of the exam following the classes are presented in the Table 3.

Table 3. Students' Mathematics Problem-Solving Posttest Ability

Class	N	Mean	SD	Min	Max
Experimen (SQ3R)	36	80.72	5.8	58	95
Control (Conventional)	36	71.53	4.5	45	85

Table 3 shows that the experimental group had a much bigger improvement in scores than the control group. This difference shows that the SQ3R strategy works well in helping students better understand information, come up with solutions, do calculations, and check their results properly.

From a statistical perspective, the t-test results of the posttest data revealed a significant difference between the two groups ($p < 0.001$). This finding confirms that the SQ3R strategy contributes meaningfully to the improvement of students' mathematical problem-solving skills. The results are consistent with prior studies, which reported that active literacy-based strategies such as SQ3R foster students' conceptual understanding and cognitive engagement (Rahayuningsih & Kristiawan, 2021; Riansyah, 2022).

The integration of the SQ3R strategy into mathematics instruction enables students to concentrate on a structured thinking process: beginning with surveying problems, generating key questions, reading and comprehending relevant information, retaining essential points, and finally reviewing and evaluating solutions. Each stage of the SQ3R approach stimulates active and reflective thinking, which is essential for addressing mathematical problems comprehensively.

Normality Test

The assessments to determine whether the problem-solving ability scores from the pretest were normally distributed indicated that the experimental group had a computed χ^2 value of 4.71, falling short of the table value of 11.3. This indicates that the experimental group's data adheres to a normal distribution. The control group demonstrated a computed χ^2 value of 5.89, which is less than the table value of 11.9, indicating that their data adheres to a normal distribution as well.

For the posttest results, analysis of the final test data in relation to the normality test revealed that the experimental class produced χ^2_calculated = 7.56, while the control class obtained χ^2_calculated = 10.39. Both values were lower than χ^2_table = 11.3, indicating that the posttest data of both groups followed a normal distribution.

Homogenity Test

According to the evaluation of the pretest results, the scores for the experimental and control groups were uniformly distributed. The same was true for the final test scores, showing similar even distribution. For the pretest, the calculated F value was 1.10, which is less than the table value of 2.29. For the posttest, the calculated F value was 1.23, also less than the table value of 2.29.

Hypothesis Test

Because the pretest and posttest results followed a normal distribution and had similar variability, we used an independent sample t-test to test our hypothesis. This analysis aimed to find out if there was a significant difference in performance between the experimental group, which learned using the SQ3R method, and the control group, which learned through traditional methods.

Table 4 displays the results of the pretest score comparison between the two groups prior to treatment. This

Table 4. Comparison of Experimental Class and Control Class Pretest Result

Comparison	t	df	p-value	Mean Difference	Conclusion ($\alpha = 0.05$)
Pretest (Exp vs Ctrl)	0.27	70	0.79	0.81	Not Significant
Posttest (Exp vs Ctrl)	3.89	70	<0.001	9.19	Significant

comparison aimed to confirm that there were no significant differences in their initial abilities, thereby establishing that both groups started with an equivalent level of competence.

The independent sample analysis of pretest scores yielded $t(70) = 0.27$ with $p = 0.79$ ($\alpha = 0.05$). Since the p-value exceeded 0.05, It can be said that the experimental and control groups started with similar levels of ability. The mean difference of 0.81 further indicates that the average pretest scores of both groups were nearly identical, thereby fulfilling the equivalence requirement for assessing the impact of the treatment.

A t-test analyzing the scores post-test indicated a t-value of 3.89, with 70 degrees of freedom and a p-value lower than 0.001. As this p-value is below the standard significance threshold of 0.05, it indicates a notable difference between the two groups following the treatment. The mean score difference was 9.19, indicating that the experimental group made significantly greater improvements than the control group. This finding indicates that the SQ3R strategy enhanced students' ability to solve math problems.

In addition to comparing the pretest and posttest results between different groups, they also checked if each group improved significantly in problem-solving skills before and after the treatment. To do this, they used a paired sample t-test to see how effective the learning was within each group on its own.

SQ3R strategy and regular teaching methods each helped improve students' ability to solve math problems.

Develop

Two activities are carried out at the development stage: expert validation and developmental testing (Thiagarajan et al., 1974). The goal of these two stages is to see the validity of the Relation and Function product prototype worksheet bai-N in theoretical and empirical terms. Thus, the prototype relation and Function worksheet based on Tri-N could be a hypothetical product ready to be tested on a large scale.

The validation expert activity involved three mathematics education lecturers and three junior high school mathematics teachers. Their involvement at this stage is to become a validator whose job is to provide assessments, suggestions, and criticism product of the Relation and Function worksheet based on Tri-N. The Tri-N worksheet based Relation and Function product assessment refers to indicators (1) design and Layout, (2) mathematical content, (3) Tri-N content, and (4) language.

In the design and layout indicators, it consists of 6 sub-indicators, namely (1) initial appearance (cover), (2) font type and font size, (3) figure, (4) colour and appearance, (5) the attractiveness of the worksheet, and (6) the identity of the author. The validation results on this indicator can be seen in Table 5.

Table 5. Paired Sample (Pre-Post in Group) Test Experimental and Control Class

Group	t-statistic	Df	p-value (2-tailed)	Mean Difference
Experiment (Pre-Post)	-12,85	35	0,00	-29,61
Control (Pre-Post)	-9,23	35	0,00	-21,22

Table 5 shows the results from a paired t-test comparing the scores before and after the test for both groups. These results help us understand how much the

The results of the Paired Sample t-test shown in Table 5 indicate a significant difference in the pretest and posttest scores for both the experimental and control groups. In the experimental group taught with the SQ3R strategy, the t-statistic was -12.85 and the p-value (2-tailed) was 0.00 < 0.05, showing a notable enhancement in mathematical problem-solving skills. The average difference of -29.61 indicates that the posttest score was significantly greater than the pretest, demonstrating a notable advancement.

In the control group that received conventional instruction, the t-statistic was -9.23 with a p-value of 0.00 < 0.05, which also indicated an increase in problem-solving ability. However, the mean difference of -21.22 was lower compared to the experimental group. This suggests that while conventional learning contributes to improved outcomes, the extent of progress is smaller than that achieved through the SQ3R strategy.

To strengthen the quantitative evidence, an N-Gain analysis was conducted to measure the relative improvement of students' learning outcomes. The experimental class achieved an average N-Gain score of 0.61, categorized as moderate to high, while the control class obtained 0.43, categorized as moderate. This indicates that the SQ3R strategy yielded a greater learning gain compared to conventional methods.

Table 6. N-Gain Summary of Students' Problem Solving Ability

Class	Pretest Mean	Posttest Mean	N-Gain	Category
Experiment (SQ3R)	51.11	80.72	0.61	Moderate to High
Control (Conventional)	50.31	71.53	0.43	Moderate

These findings confirm that the experimental group demonstrated a higher normalized gain, reinforcing the effectiveness of the SQ3R approach in enhancing mathematical problem-solving performance.

These results confirm that the SQ3R strategy is more effective than conventional teaching in improving students' mathematical problem-solving skills, particularly in the topic of triangles. The SQ3R method involves steps like Survey, Question, Read, Recite, and Review, which help students understand ideas better, link concepts to real-life situations, and develop thinking skills needed to solve problems effectively.

The statistical results demonstrated that both groups started with similar initial abilities (p = 0.79), but the posttest results showed a significant difference (p < 0.001) in favor of the experimental group. The average improvement was 29.61 points for the experimental group and 21.22 points for the control group.

Furthermore, the N-Gain analysis showed that the experimental class achieved a score of 0.61 (moderate to high), while the control class obtained 0.43 (moderate). This indicates that students who learned through the SQ3R strategy experienced greater relative improvement in understanding and applying mathematical concepts.

Qualitative Findings from Student Interviews

To complement the quantitative analysis, qualitative data were gathered through student interviews to explore their perceptions and experiences in learning triangles using the SQ3R strategy. The interviews aimed to reveal how students' understanding, confidence, and motivation developed during the learning process.

Before applying the SQ3R strategy,

many students reported that they initially found geometry (particularly the topic of triangles) difficult to understand. They expressed confusion about how to determine the properties of triangles, calculate their area, and apply formulas in problem situations. For instance, one student stated, *"At first, I often mixed up the types of triangles and didn't know which formula to use."* Another commented, *"It was hard to remember how to find the height when only some sides were given."*

After the implementation of the SQ3R strategy, students described a noticeable improvement in their comprehension and confidence. They explained that the *Survey* and *Question* stages helped them identify key elements of a problem—such as given sides, angles, or area—before jumping into calculations. The *Read* and *Recite* steps encouraged them to carefully study the relationships between triangle elements and recall relevant formulas. One student shared, *"By asking questions first, I could understand what the problem was asking, and then it became easier to choose the right formula."*

Students also mentioned that the Review stage helped them detect calculation errors and confirm their reasoning, making them more confident in checking their answers. As one participant noted, *"Before, I rarely checked my results. Now, after reviewing, I realize where I made mistakes."*

In addition, the interviews revealed that students became more motivated and engaged in the learning process. Several participants reported that the SQ3R steps made lessons feel more structured and enjoyable. They were more active in discussions, asked more questions, and collaborated with peers. For example, one student said, *"Learning triangles felt easier because we discussed the questions together after reading and summarizing."*

Moreover, students found that connecting triangle concepts to real-life contexts (such as building structures, calculating land areas, or designing objects) helped them understand the material more meaningfully. One student explained, *"Now I know triangles are not just for math class; they are used in bridges and roofs too."*

Overall, the interview results indicate that the SQ3R strategy not only enhanced students' mathematical problem-solving performance but also improved their confidence, independence, and motivation in learning geometry. These qualitative findings reinforce the quantitative results and will be analyzed further in the Discussion section to interpret the theoretical and pedagogical implications.

Discussion

The findings of the study demonstrate that utilizing the SQ3R strategy markedly enhances students' mathematical problem-solving abilities in comparison to traditional learning methods. The enhancement seems consistent across all measures, with the greatest success in understanding issues and devising solutions. This is in line with the role *of the Survey* and *Question* stage in SQ3R which encourages students to actively read, identify important information, and formulate questions before starting the calculation process (Sudarsono & Astutik, 2024; Tsai et al., 2023; Yuda & Mustadi, 2025).

The interview data also confirmed these results. Several students expressed that the SQ3R approach helped them "know what to look for" before solving problems. During the Survey and Question stages, they reported becoming more confident in identifying known and unknown elements of triangle problems, such as side lengths, angles, and relationships between them. This shows that SQ3R not only improves comprehension but also promotes metacognitive awareness, allowing students to plan and monitor their own problem-solving process effectively.

Meanwhile, the indicator of re-examining the answer experienced a relatively lower increase compared to other indicators. This condition can be caused by the nature of reflective skills that require repeated practice and longer time to develop optimally. From the interviews, some students mentioned that they often "ran out of time to check their answers" or felt that once they got the answer, they didn't need to re-evaluate it. Such reflections indicate that while SQ3R supports understanding and problem-solving, the Review stage still needs continuous reinforcement through explicit teacher guidance and structured reflection exercises. Differences in achievement between indicators can also be influenced by external factors such as learning motivation, family support, previous learning experiences, and the dynamics of classroom discussions (Cook & Artino, 2016; Ramli et al., 2018).

In general, the results of this study match what was found in earlier research by Riansyah (2022) and Rahayuningsih & Kristiawan (2021). Those studies showed that the SQ3R method helps students understand ideas better and become more independent in their learning. The main difference here is that this study applies SQ3R to junior high school students with a specific focus on the topic of triangles, which requires logical and spatial reasoning. The five steps of SQ3R (Survey, Question, Read, Recite, and Review) help students find key information, work together, solve problems, and check their work in a clear and organized way.

The interview data reinforce this finding, as students stated that "reading carefully and trying to restate what the question means" made it easier to visualize the triangle and choose the right formula. This finding suggests that the Read and Recite stages of SQ3R help students translate mathematical symbols into meaningful representations, thereby strengthening spatial visualization, a critical skill in geometry.

Triangulating data through tests, observations, interviews and documentation reinforces the validity of the findings, while confirming that active literacy strategies such as SQ3R are not only beneficial in improving reading comprehension, but also effective in strengthening mathematical reasoning skills. Thus, SQ3R can be an alternative learning strategy that is relevant and applicative to improve mathematical problem-solving abilities in materials that require deep conceptual understanding and strong spatial reasoning (Bulut, 2017; Chang et al., 2017; Lawrence & Tar, 2018; Patcharapiyakul & Promnont, 2025; Sunarti et al., 2021; Wang & Degol, 2016).

Implication of Research

These findings provide important implications for teachers, particularly in the design of Learning Implementation Plans (RPPs) that integrate SQ3R measures explicitly and in a structured manner (Montgomery, 2020; Pebriantika & Aristia, 2021; Riyanti & Fauziyyah, 2025). One form of application is to add a "Question and Hypothesis" section at the beginning of the lesson to strengthen the Question stage, and a "Summary and Correction" column at the end of the problem-solving exercise to reinforce the Review stage (Amikratunnisyah &

Fatonah, 2023; Wang & Degol, 2016). Teachers can also combine this strategy with small group learning, formative feedback, and answer-checking sessions so that all indicators can develop in a balanced manner (Kregear et al., 2025; Qishta et al., 2021). In geometry, where visual and conceptual reasoning are equally important, the SQ3R stages provide a coherent scaffold that helps students connect textual, symbolic, and spatial representations in a meaningful way.

Limitation

However, this study has limitations due to the limited number of respondents and the scope of material that only focuses on the concept of triangles, so generalization of results needs to be done carefully. The interviews were also limited to a small number of participants, so the qualitative findings mainly serve to strengthen, not to generalize, the statistical results.

The implications of this study highlight the importance of teacher development and training in implementing active literacy-based learning strategies to strengthen the quality of the learning process, especially in materials that require higher-order thinking skills such as geometry. Future studies can expand the implementation of SQ3R to other mathematical concepts (e.g., quadrilaterals or circles) and use mixed methods with longer durations to explore changes in reflective and metacognitive habits over time.

CONCLUSION

This study shows that using the SQ3R method really helps junior high school students get better at solving math problems related to triangles. It helps them understand the problems, plan how to solve them, do the math steps correctly, and check their answers in a clear and organized way. Quantitative analysis showed a significant improvement in the experimental group ($p < 0.001$) with moderate to high N-Gain values, while interview data revealed that students became more confident, active, and reflective when learning mathematics through SQ3R.

The integration of SQ3R not only improved comprehension but also developed students' metacognitive and reasoning abilities, confirming its relevance as an active literacy-based learning approach. Although limited to the topic of triangles and a small sample size, the findings emphasize the importance of teacher training in implementing structured reading and questioning strategies. Future research should expand the use of SQ3R to other geometry materials and investigate its long-term effects on students' reflective and analytical thinking skills.

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